The Acutely Infected Diabetic Foot Is Not Adequately Evaluated in an Inpatient Setting

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Objective: To evaluate the standard of evaluation and treatment of the infected diabetic foot ulceration at a 551-bed university teaching institution.


Population: Two hundred fifty-five patients who were admitted to a hospital for care of an infected diabetic foot ulceration. Patients were subdivided into the following 4 dichotomous variables: (1) whether the patient underwent a lower-extremity amputation, (2) whether the patient was admitted once or multiple times, (3) whether the patient underwent intraoperative debridement, and (4) whether the patient was admitted to medical or surgical services.

Results: All groups that were evaluated had undergone a less than adequate foot examination. Of the admitted patients, 31.4% did not have their pedal pulses documented; 59.7% of the admitted patients were not evaluated for the presence or absence of protective sensation. Nearly 90% of the wounds were not evaluated for involvement of underlying structures, and foot radiographs were not performed in 32.9% of the patients. There were more blood cultures ordered (62.0%) than wound cultures (51.4%).

Conclusion: The results of this study highlight the need for a systematic, detailed lower-extremity examination for every diabetic patient who is admitted to a hospital, particularly those who are admitted with a primary diagnosis that involves a foot complication.

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DIABETES IS the most common underlying cause of lower-extremity amputations in the United States and Europe. Of the approximately 125,000 lower-extremity amputations that are performed each year, 50% to 80% are directly attributable to diabetes mellitus. Individuals with diabetes have a 15- to 30-fold greater risk of lower-extremity amputation than those without diabetes. The most common components in the causal pathway to loss of a limb in patients with diabetes mellitus include peripheral neuropathy, peripheral vascular disease, structural deformity, ulceration, and infection. Treatment of infected foot wounds accounts for up to one quarter of all diabetic patients who are admitted to hospitals in the United States and Great Britain. Evaluation of these parameters is critical in the start of appropriate treatment of the high-risk diabetic patient.

We have observed that patients who are admitted for care of diabetic foot infections are often not adequately evaluated according to the standards that have been set by the American Diabetes Association, Bethesda, Md. In an outpatient setting, feet are rarely examined during a regularly scheduled visit for patients with diabetes. However, we have been unable to find any information in the medical literature that evaluates the quality of a foot examination on an inpatient basis.

We would expect that the more severe the infection, the more closely the patient would be evaluated during his or her admission. The purpose of this study is to evaluate the standard of treatment of the diabetic foot infection at a university teaching institution.

RESULTS

Of 255 consecutively admitted patients, 144 were male and 111 were female, with a mean ±SD age of 59.9 ±14.0 years (Table 1). Only 35.7% of the patients who were admitted for infected foot ulcers had the size of their wound recorded. Evaluation
PATIENTS AND METHODS

Participants in this review were patients who were admitted to a 551-bed university teaching hospital between January 1, 1991, and December 31, 1994, with a primary diagnosis of an infected diabetic foot ulceration. Patients were identified by using codes 250.8 and 707.1 according to the International Classification of Diseases, Ninth Revision, Clinical Modification. We abstracted medical records to identify World Health Organization, Geneva, Switzerland, mellitus by using the criteria set forth by the group included those who were admitted to the Departments of Internal Medicine or Family Practice. The "surgery" patients who were admitted to the Departments of In-ables: lower-extremity amputation, multiple hospi-teristics) was present.

Above wound descriptors (size, depth, or characters-considered to be adequate if documentation of 2 of the competencies score, the wound evaluation was con-

representation what we considered minimal evaluation cri-
scheme because when they were combined, they rep-

determination vs those who were not (74.1% vs 67.2%, P < .05). Patients who had angiograms performed did not have their pedal pulse checked significantly more often than those who did not have angiograms done (75.6% vs 67.3%, P < .05). While patients who underwent Doppler noninvasive vascular examinations had their pulses examined more often than those who did not (79.3% vs 64.0%; OR, 2.2, Cl, 1.2-4.1; P = .02), we were surprised by the fact that more than 20% of the patients who underwent this ancillary examination did not first have their pulses evaluated.

Twenty-two percent of the patients who were admitted underwent a lower-extremity amputation as a result of their foot infection. Most of these amputations were partial foot amputations that involved a digit or ray (Figure). There was not a significant difference between any of the parameters that we reviewed among patients who required an amputation and those who did not require amputation (Table 2). Nearly all patients who were reviewed, regardless of the presence or absence of an amputation during the hospitalization, underwent a less than adequate wound evaluation, with only 8% of the patients who were admitted having size, depth, and description of the wound documented. The mean ± SD wound evaluation score was 1.1 ± 1.0 for all admissions. No patients who underwent a high level (transfemoral or transtibial) amputation had all 3 descriptors documented. In fact, 57% of those patients had no wound descriptors documented (Table 3). The minimum mean ± SD wound evaluation competency score was 1.6 ± 0.9 for all patients who were admitted. Pulses were evaluated in 68.6% of the patients. At admission, 21% of the patients were taking a rheologic agent (pentoxifylline) for treatment of peripheral vascular disease. There was not a significant difference in pulse evaluation in those who were taking the medication vs those who were not (74.1% vs 67.2%, P < .05). Patients who had angiograms performed did not have their pedal pulse checked significantly more often than those who did not have angiograms done (75.6% vs 67.3%, P < .05). While patients who underwent Doppler noninvasive vascular examinations had their pulses examined more often than those who did not (79.3% vs 64.0%; OR, 2.2, CI, 1.2-4.1; P = .02), we were surprised by the fact that more than 20% of the patients who underwent this ancillary examination did not first have their pulses evaluated.

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Patients who were admitted multiple times for a foot infection constituted 51.8% of all those studied. These patients received a documented wound description significantly more frequently than did those in the group with single admissions (Table 4). The group with multiple admissions was 1.8 times more likely to undergo an intraoperative debridement (81.1% vs 70.1%, CI, 1.0-3.2; P = .05) and 2.6 times more likely to receive home health care following discharge (15.2% vs 6.5%; CI, 1.1-6.1; P = .04). Seventy-six percent of the patients who were admitted underwent surgical debridement. Those who underwent debridement were more than 8 times more likely...
to have the generalized appearance of the wound and wound drainage evaluated. These patients were nearly twice as likely to have wound cultures taken (Table 5).

There was no difference in home health care referral rates or in the rate of lower-extremity bypass grafting among those who underwent surgical debridement ($P > .05$).

The medicine and surgery groups showed little statistical difference in the evaluation parameters. These data are summarized in Table 6. However, we noticed a trend toward more laboratory tests and radiographic studies ordered by the medicine group. The surgeons showed a slightly greater percentage of wounds that were evaluated, as well as documented lower-extremity vascular and sensory testing. Patients who were admitted to a medicine service were more than 3 times more likely to have multiple consultations than those who were admitted to a surgical service. Patients who were admitted to a surgical service also were significantly more likely to have a lower-extremity arterial bypass graft (13% vs 4.5%; OR, 3.2; CI, 1.1-9.0; $P = .05$). The patients in the surgery group were more likely to be admitted multiple times (70.4% vs 40.8%; OR, 2.7; CI, 1.4-5.2; $P = .003$). There was not a significant difference in lower-extremity amputations, number of surgical debridements, or home health care utilization after discharge between the 2 groups ($P > .05$).

Wound care techniques were also evaluated. Nearly half (48.2%) of the patients who were admitted received no specific orders or instructions for daily wound care. Wet to dry dressings with normal saline solution were prescribed for 22.7% of the patients who were admitted. Soaks or whirlpool therapy was ordered for 16.5% of the patients who were admitted. Gels or alginates were used on 6.3% of the patients who were admitted. Iodine-soaked gauze was applied on 4.3% of the admitted patients’ foot infections. Hydrogen peroxide-soaked gauze was ordered for 2% of the patients. There were no significant differences in the wound care regimen that was ordered based on any of the dichotomous groups that were studied.

At discharge, all patients who underwent an amputation at the transfemoral (above-knee) or transtibial (below-knee) level had a specific plan for rehabilitation or amputation stump accommodation. Of all other patients who were admitted, only 1.6% were discharged with arrangements that were made for home health wound care.

The results of this study highlight the need for a systematic, detailed lower-extremity examination for every dia-
The physical examination did not affect the outcome. Without independent objective evaluation for each patient, it would be difficult to determine whether amputations were performed unnecessarily or conversely, if an ablative procedure was in fact indicated. Clearly, a prospective observational study to determine the effect of evaluation on outcome is indicated.

The American Diabetes Association has set forth generalized recommendations for a foot examination. These guidelines suggest that a foot examination should be performed at every regular outpatient visit. However, it has been well established that the feet are infrequently examined during a general physical examination on an outpatient basis. On a diabetic patient’s routine visit to a primary care physician, foot examinations are only performed between 10% and 19% of the time.14,15 It seems reasonable that a lower-extremity examination in patients who are admitted with a primary diagnosis of a diabetic foot infection would be performed far more frequently and thoroughly. We were surprised that in the vast majority of the inpatient population reviewed, this was not the case.

Qualitative and quantitative analysis of the ulcer isbeti c person who is admitted to a hospital, particularly those who are admitted with a primary diagnosis that involves a foot complication. We expected that patients who were admitted for more severe diabetes-related lower-extremity sequelae would be evaluated more closely, particularly if they were to undergo a lower-extremity amputation; this was not supported by the findings. The quality of the examination was inadequate in all subgroups. Less than 14% of all patients who were admitted met all 3 criteria for minimum evaluation competency.

The decision to amputate is based on several parameters. These include wound and infection severity, degree of peripheral arterial occlusive disease, ambulatory status of the patient, and a variety of other psychosocial factors. There were significant differences in the thoroughness of wound evaluation and minimum evaluation competency scores in patients with proximal amputations compared with those in patients with foot amputations or no amputation. However, we cannot be certain that significant comorbidities or other factors in the decision-making process besides basic elements in the physical examination did not affect the outcome. Without independent objective evaluation for each patient, it would be difficult to determine whether amputations were performed unnecessarily or conversely, if an ablative procedure was in fact indicated. Clearly, a prospective observational study to determine the effect of evaluation on outcome is indicated.

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Table 3. Wound Evaluation Score and Minimum Evaluation Competency Score by Amputation Outcome

<table>
<thead>
<tr>
<th>Score</th>
<th>Wound evaluation</th>
<th>Minimum evaluation competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Total</td>
<td>High-Level vs Foot Amputation</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1</td>
<td>15.6</td>
<td>75.0</td>
</tr>
<tr>
<td>2</td>
<td>12.5</td>
<td>72.5</td>
</tr>
<tr>
<td>3</td>
<td>10.0</td>
<td>65.0</td>
</tr>
</tbody>
</table>

Table 4. Evaluation by Multiple Admissions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>% of Patients</th>
<th>Multiple Admissions</th>
<th>Single Admission</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound description</td>
<td>69.7</td>
<td>56.1</td>
<td>1.0 (1.1-3.0)†</td>
<td></td>
</tr>
<tr>
<td>Wound size</td>
<td>40.9</td>
<td>30.0</td>
<td>1.6 (1.0-2.7)</td>
<td></td>
</tr>
<tr>
<td>Sensory</td>
<td>44.7</td>
<td>35.8</td>
<td>1.8 (0.9-2.4)</td>
<td></td>
</tr>
<tr>
<td>Wound depth</td>
<td>12.9</td>
<td>7.3</td>
<td>1.9 (0.8-4.4)</td>
<td></td>
</tr>
<tr>
<td>Lower-extremity angiogram</td>
<td>18.9</td>
<td>13.0</td>
<td>1.6 (0.8-3.1)†</td>
<td></td>
</tr>
<tr>
<td>Foot x-ray film</td>
<td>70.5</td>
<td>63.4</td>
<td>1.4 (0.8-2.3)†</td>
<td></td>
</tr>
<tr>
<td>Doppler examination</td>
<td>34.0</td>
<td>30.0</td>
<td>1.2 (0.7-2.0)†</td>
<td></td>
</tr>
<tr>
<td>Pulse</td>
<td>70.5</td>
<td>66.7</td>
<td>1.2 (0.7-2.0)†</td>
<td></td>
</tr>
<tr>
<td>Wound culture</td>
<td>50.0</td>
<td>52.8</td>
<td>0.9 (0.6-1.5)†</td>
<td></td>
</tr>
<tr>
<td>Blood culture</td>
<td>61.4</td>
<td>62.6</td>
<td>1.0 (0.6-1.6)†</td>
<td></td>
</tr>
<tr>
<td>Bone scan</td>
<td>39.4</td>
<td>38.2</td>
<td>1.1 (0.6-1.7)†</td>
<td></td>
</tr>
</tbody>
</table>

*OR indicates odds ratio; CI, confidence interval.
†P<.05.

Table 5. Evaluation by Surgical Débridement

<table>
<thead>
<tr>
<th>Parameter</th>
<th>% of Patients</th>
<th>Intraoperative Débridement</th>
<th>No Surgical Débridement</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound description</td>
<td>74.7</td>
<td>26.2</td>
<td>8.3 (4.3-16.0)†</td>
<td></td>
</tr>
<tr>
<td>Lower-extremity angiogram</td>
<td>12.3</td>
<td>27.9</td>
<td>2.7 (1.4-5.6)†</td>
<td></td>
</tr>
<tr>
<td>Wound size</td>
<td>40.2</td>
<td>21.3</td>
<td>2.5 (1.3-4.9)†</td>
<td></td>
</tr>
<tr>
<td>Wound depth</td>
<td>12.4</td>
<td>3.3</td>
<td>4.2 (1.0-18.3)†</td>
<td></td>
</tr>
<tr>
<td>Wound culture</td>
<td>55.2</td>
<td>39.3</td>
<td>1.9 (1.1-3.4)†</td>
<td></td>
</tr>
<tr>
<td>Blood culture</td>
<td>63.9</td>
<td>55.7</td>
<td>1.4 (0.8-2.5)†</td>
<td></td>
</tr>
<tr>
<td>Sensory</td>
<td>42.3</td>
<td>34.4</td>
<td>1.4 (0.8-2.5)†</td>
<td></td>
</tr>
<tr>
<td>Doppler examination</td>
<td>33.0</td>
<td>29.5</td>
<td>1.2 (0.6-2.2)†</td>
<td></td>
</tr>
<tr>
<td>Pulse</td>
<td>68.0</td>
<td>70.5</td>
<td>0.9 (0.5-1.7)</td>
<td></td>
</tr>
<tr>
<td>Foot x-ray film</td>
<td>67.5</td>
<td>65.6</td>
<td>1.1 (0.6-2.0)†</td>
<td></td>
</tr>
<tr>
<td>Bone scan</td>
<td>38.7</td>
<td>39.3</td>
<td>1.0 (0.9-1.1)†</td>
<td></td>
</tr>
</tbody>
</table>

*OR indicates odds ratio; CI, confidence interval.
†P<.05.
Critical in establishing an overall treatment plan. The cause of the ulceration should be recognized to establish a treat-
ment regimen and also for future prevention. Dimensions of the ulcer should be recorded to help monitor the
progression of treatment. It is essential to document the depth of the ulcer and the involvement of underlying
structures (tendon, joint capsule, or bone). This may be performed with a sterile blunt probe. Serous or puru-
lent drainage should be distinguished with a further description of color and odor, as necessary. The base of the
ulcer may be classified as granular, fibrotic, or necrotic. Wound margins should be described as viable or non-
viable. Periwound descriptors may include the presence or absence of edema, erythema, fluctuation, or subcuta-
neous emphysema. The involved extremity should be examined for lymphangitis, lymphadenopathy, and cellulitis.
A complete bilateral dermatologic examination (including inspection between the toes and posterior as-
pects of the heels) is recommended to rule out other ulcerations or sources of contiguous infection. In this study,
a wound description was documented in 63%, wound size documented in 31.4% of the patients. In this study, docu-
mentation. Following resolution of infection, a specific plan to off-weight the affected area should be started.
This may include contact casting, complete non-weight-bearing devices (eg, crutches or wheelchair), or custom-
fabricated braces or sandals. Only 1.6% of the patients had any of these modalities prescribed at discharge.

In summary, the standard of evaluation of treat-
mant of the infected diabetic foot was generally not met. Several authors have advocated the team approach in the
treatment of the diabetic foot ulcer as both a more effi-
cacious and a more cost-effective means of limb sal-
vage. When utilized, this approach has reportedly re-
duced the incidence of lower-extremity amputation and has reduced hospital stay by an average of 33%. We ob-
served no team approach, no obvious pattern of referr-
al, and no specific treatment algorithm followed for the
patient population that was reviewed in this study.

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REFERENCES


